

SARDINIAN DEER: DERIVATIONS, FOSSIL DISCOVERIES AND CURRENT DISTRIBUTION

Stefano Melis¹, Suzana Salvadori², Gian Luigi Pillola³

Key words: *Praemegaceros cazioti*, *Cervus elaphus corsicanus*, Sardinia.

Abstract: The main purpose of my work is to describe and to apply the current method of census of roving of Sardinian deer, and to deepen the aspect of his derivations and the fossil discoveries concerning the presence of cervids in Sardinia in the Quaternary. I focused this work on the fossil endemic species *Praemegaceros cazioti* and on the actual endemic species *Cervus elaphus corsicanus*, because I wanted to obtain the most complete view about their morphological and evolutive characteristics.

Introduction

It is very important to specify that the two species of deer that populated Sardinia in different periods of time belong to two distinct genus of the family of cervids, so they don't have bonds of consanguinity. The first cervids appeared in Asia in the Miocene and they spread in Europe and North America in the Middle Pleistocene. The aspect of the fossil discoveries shows that *Praemegaceros cazioti* descends from some exemplars of the continental species *Praemegaceros verticornis* that came in Sardinia 800.000 years ago, through the Tuscan archipelago, a natural connection; Sardinia and Corsica formed a single block in this period. The rests of *Praemegaceros cazioti* are relatively common, especially in aeolian deposits and in caves, the most famous fossiliferous places are Su Fossu de Cannas Cave, Dragonara Cave, Corbeddu Cave, Porto Paglia, San Giovanni di Sinis, Monte Tuttavista and Capo Figari. The analysis of these fossils showed that *Praemegaceros cazioti* was smaller than the continental ancestor *Praemegaceros verticornis* because he suffered of the so-called phenomenon of insularity, due to his adaptation to a limited surface, a scarceness of food and an absence of plunderers. This analysis also showed that *Praemegaceros cazioti* died out 7.500 years ago as a consequence of the arrival of the Neolithic man in Sardinia;

¹ Università degli Studi di Cagliari, Sardegna

² Università degli Studi di Cagliari, Dipartimento di Biologia Animale ed Ecologia

³ Università degli Studi di Cagliari, Dipartimento di Scienze della Terra

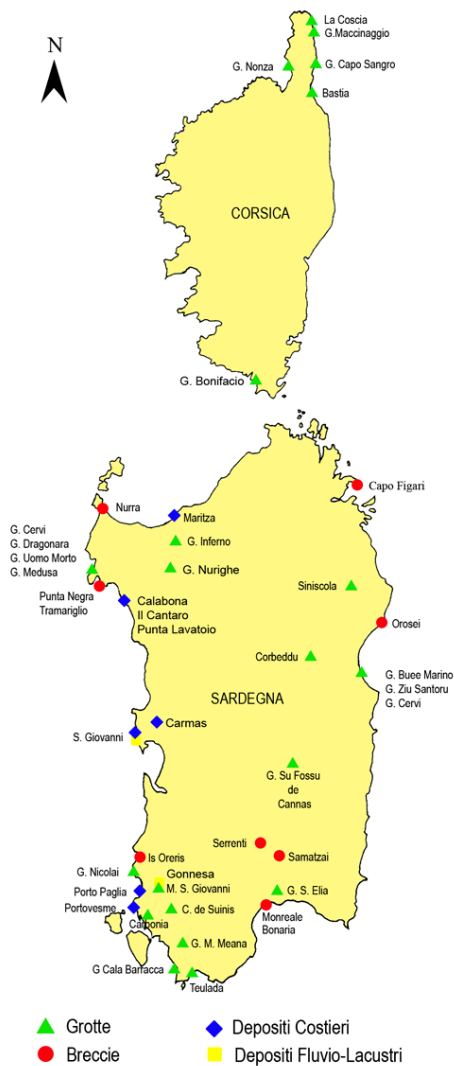


Fig. 1 - Distribution of the rests of *Praemegaceros cazioti* (Fanelli, 2008)

therefore, it survived for about 800.000 years; finally, this animal was a mixed feeder and its diet consisted of abundant grasses, woody plants and fruits.

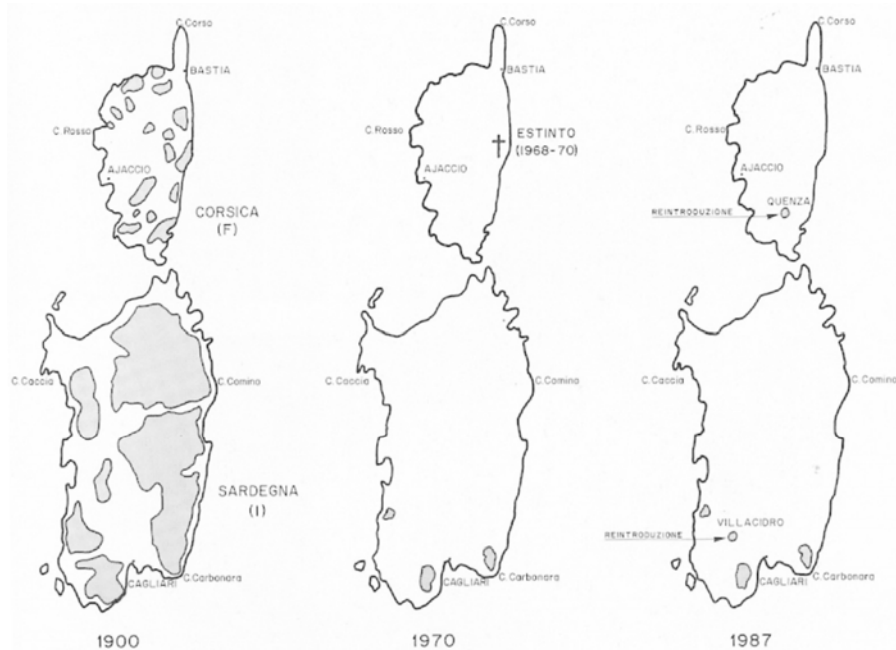


Fig. 2 - Distribution of *Cervus elaphus corsicanus* in the XX century (Beccu, 1989)

The aspect of the current distribution of cervids in Sardinia shows the presence of the endemic deer *Cervus elaphus corsicanus*: it is a subspecies of the continental species *Cervus elaphus*, its habitat consists of dense forest lands of the so-called “Mediterranean Thicket”, it was historically common in many places of Sardinia, but today it can be found in the three areas of Sulcis, Sarrabus and Arbus-Montevicchio. The rests of *Cervus elaphus corsicanus* (discovered in different nuragic places of Sardinia) testify its real presence for 3.500 years; this suggests the human introduction of deer in Sardinia, so *Cervus elaphus corsicanus* descends from some exemplars of the continental species *Cervus elaphus* that probably was brought in Sardinia by humans.

Materials, methods and acquired data

I analyzed and photographed some fossils in the Department of Geologic Sciences of the University of Cagliari, partly belonging to the fossil endemic species *Praemegaceros cazioti* and partly to the actual endemic species *Cervus elaphus corsicanus*, because I wanted to obtain a comparison of some characters that were observed on the material available for both species.

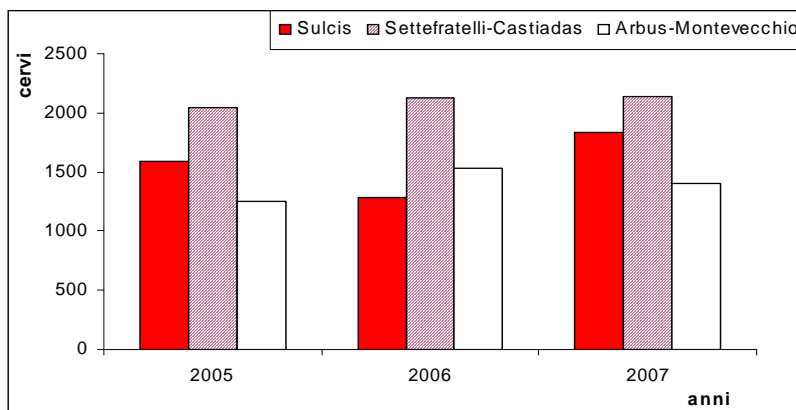


Fig. 3 - Graphic of the population of *Cervus elaphus corsicanus*. Ente Foreste della Sardegna, 2007

Tab. 1 - Data of the census of roaring of *Cervus elaphus corsicanus*. Ente Foreste della Sardegna, 2007

Area	N° roaring deers	Total n° of deer
Settefratelli - Castiadas	428	2145
Sulcis	367	1835
Arbus - Montevecchio	307	1405
Monte Lerno	28	186
Monte Linas	30	150
Monte Arcosu	200	1000
Enclosures	0	475
TOTAL	1360	7196

Considering the available material and the high systematic value of the teeth and the morphology of the antlers, I made comparisons of teeth and antlers. The analysis of fossil samples shows first that the mandibles of the fossil endemic species *Praemegaceros cazioti* and of the actual endemic species *Cervus elaphus corsicanus* differed greatly in size, with the prevalence of the first. The analysis also shows that the size and morphology of the teeth are different: *Praemegaceros cazioti* has larger teeth with a long crown (hypsodont teeth), while *Cervus elaphus corsicanus* has smaller and less specialized teeth; this suggests that the two species have different alimentary habits. In September 2007, I took part in the census of roaring of *Cervus elaphus corsicanus*, an important initiative supported by the Ente

Foreste of Sardinia in collaboration with the Department of Animal Biology and Ecology of the University of Cagliari. The census was conducted in the three historic areas where the Sardinian deer lives (Sulcis, Sarrabus and Arbus-Montevicchio) for about fifteen days and directly involved the students of Natural Sciences of the University of Cagliari and the staff of the Ente Foreste. The method of census of roaring allowed us to estimate the population from the census of adult males, which became manifest through their vocal activities in the period of the heats (roars) during the night. The census required the operators, who were located in fixed and known points, geo-referenced with the use of GPS, to listen and record the roars. Two operators (a student and an employee of the Ente Foreste) occupied all listening points. During the sessions of census, every detector drew up a report in which he signaled the direction of origin of the roars, the acoustic distance, the hour (in sessions of ten minutes) and the number of the roars. Results were processed and mapped using the GIS. The graphic processing of the information contained in the detection allowed us to approximate (through triangulations) the position and the total number of the deer roaring. The data provided the information necessary to calculate the density of adult males and, with subsequent extrapolations, the density and texture of the population. The census was conducted between the 4th and the 19th of September. Roars were listened to between the hours 20 and 22 from fixed locations, chosen to allow maximum acoustic coverage. The data collected in this work allowed us to estimate a population, in the areas surveyed, of 5.721 deer. Considering that in the enclosures managed by the Ente Foreste there were 475 heads and in the WWF Natural Reserve of Monte Arcosu there were about 1.000, we could estimate a population of 7196 deer, of which 6721 in the wild.

Conclusions

In this paper, I analyzed the issues concerning the derivations of cervids in Sardinia and the paleontological evidences about it, and I realized that some aspects are still open and object of great discussions; therefore, they would require new studies, more accurate and detailed, to confirm or not the assumptions currently accredited. I also analyzed the method of census of roaring, an important initiative promoted by the Ente Forest of Sardinia; a continuous monitoring of the population of Sardinian deer is useful. This initiative developed for twenty years and it gave till now satisfactory results for the preservation of this species; it started to respond actively to the serious threat of extinction that struck particularly the *Cervus elaphus corsicanus* in the last century; in fact, the population in the 1980' was so small that there were just 100-170 exemplars. It is obvious that we need an accurate monitoring of *Cervus elaphus corsicanus* through the census, the study of the structure of the population and the periodic sanitary analysis. The

results will allow plans of management that favors the preservation of the species, its reintroduction in areas where it was historically present and the maintenance of the density of the population within limits that allow good relations with man and his activities.

Acknowledgement. The writing of this work was made possible by the contribution of many people that I would like to thank. I thank Luciano Mandas, Ph.D and all the operators of the Ente Foreste of Sardinia for providing me all the material necessary to explain the current distribution of this species. An appropriate and sincere thanks must be made in particular to my reporters, who have supported my thesis idea and gave me excellent indications on its setting. I thank professor Salvadori for the help and the availability in the biological treatment of the species object of study, for giving an appropriate setting of the work and for providing me various theses concerning the Sardinian deer. I thank Professor Pillola for the help and the availability in establishing the treatment of the derivations of this species and the paleontological evidences, for providing an adequate and updated bibliography and for making available the laboratory and the fossil samples, useful for the treatment of the experimental part of my work.

Bibliography:

- Abbazzi I., Angelone C., Arca M., Barisone G., Bedetti C., Delfino M., Kotsakis T., Marcolini F., Palombo M.R., Pavia M., Piras P., Rook L., Torre D., Tuveri C., Valli A., Wilkens B.** (2004), *Plio-Pleistocene fossil vertebrate of Monte Tuttavista (Orosei, eastern Sardinia), an overview*. Rivista italiana di Paleontologia e stratigrafia, volume 110, pp. 681-706
- Abbazzi L.** (2004), *Remarks on the validity of the generic name Praemegaceros Portis 1920, and an overview on Praemegaceros species in Italy*. Rend.Fis.Acc.Lincei, volume 15, pp. 115-132
- Beccu E.** (1989), *Il cervo sardo. Origini, biologia, diffusione, ambiente e salvaguardia della specie*. Carlo Delfino Editore
- Benzi V., Abbazzi L., Bartolomei P., Esposito M., Fassò C., Fonzo O., Giampieri R., Murgia F., Reyss J.L.** (2007), *Radiocarbon and U-series dating of the endemic Praemegaceros cazioti (Depèret) from "Grotta Juntu", Sardinia*. Journal of the Archaeological Science, volume 34, pp. 790-794
- Caloi L., Malatesta A.** (1974), *Il cervo pleistocenico di Sardegna*. Estratto da: *Studi di Paleontologia, Paleoantropologia, Paleontologia e Geologia del Quaternario*. Volume 2
- Caloi L., Palombo M.R.** (1991), *Morfologia e funzione della mano e del piede del megacero del Pleistocene Superiore di Dragonara (Sardegna, Italia)*. Estratto da: *Atti Accademia Peloritana dei Pericolanti*. Volume 67, supplemento 1

- Caloi L., Palombo M.R.** (1995), *Functional aspects and ecological implication in Pleistocene endemic cervids of Sardinia, Sicily and Crete*. *Geobios*, volume 28, pp. 247-258
- Carmignani L., Oggiano G., Barca S., Conti P., Salvadori I., Eltrudis A., Funedda A., Pasci S.** (2001), *Geologia della Sardegna. Note illustrative della Carta Geologica della Sardegna a scala 1:200.000*. Estratto da: *Memorie descrittive della Carta Geologica d'Italia*. Volume 60. Istituto Poligrafico e Zecca dello Stato
- Chesi F., Delfino M., Abbazzi L., Carboni S., Lecca L., Rook L.** (2007), *New fossil vertebrate remains from San Giovanni di Sinis (Late Pleistocene, Sardinia): the last *Mauremys* (Reptilia, Testudines) in the central Mediterranean*. *Rivista italiana di Paleontologia e stratigrafia*, volume 113, pp. 287-297
- Croitor R.** (2004), *Systematic and phylogeny of large-sized deer of the genus *Praemegaceros* Portis, 1920 (Cervidae, Mammalia)*. 18th International Senckenberg Conference 2004 in Weimar
- Fanelli F., Palombo M.R., Pillola G.L., Ibba A.** (2007), *Tracks and trackways of "Praemegaceros" cazioti (Depèret, 1897) (Arctiodactyla, Cervidae) in Pleistocene coastal deposits from Sardinia (Western Mediterranean, Italy)*. *Bollettino della Società Italiana Paleontologica*, volume 46, pp. 47-54
- Fanelli F.** (2008), *Depositi costieri pleistocenici del SW della Sardegna e popolamento a cervidi: paleoambienti e paleo icnologia*. Tesi di dottorato, Università degli Studi di Cagliari
- Grussu F.** (2007), *Origine, biologia e densità della popolazione del cervo sardo (*Cervus elaphus corsicanus*)*. Tesi di laurea, Università degli Studi di Cagliari
- Melis R.T., Palombo M.R., Mussi M.** (2002), *The stratigraphic sequence of Gonnese (Sw Sardinia): paleoenvironmental, paleontological and archaeological evidence*. *World island in prehistory*, volume 40
- Mereu F.** (2006), *Censimento al bramito del cervo sardo (*Cervus elaphus corsicanus*) nell'areale di Montevecchio*. Tesi di laurea, Università degli Studi di Cagliari
- Murgia C., Murgia A., Deiana A.M.** (2005), *Sedici anni di censimenti del cervo sardo (*Cervus elaphus corsicanus*) nella riserva naturale WWF di Monte Arcosu*. *Rendiconti Seminario Facoltà Scienze Università Cagliari*, volume 75, fasc. 1-2
- Palombo M.R.** (2005), *Food habits of "Praemegaceros" cazioti (Depèret, 1897) from Dragonara Cave (Nw Sardinia, Italy) inferred from cranial morphology and dental wear*. *Insular Vertebrate Evolution*, volume 24
- Palombo M.R.** (2006), *Biochronology of the Plio-Pleistocene Terrestrial mammals of Sardinia: The state of the art*. *Hellenic Journal of Geosciences*, volume 41, pp. 47-66
- Palombo M.R., Melis R.T.** (2005), *Su Fossu de Cannas Cave (sadali, central-eastern Sardinia, Italy): the earliest deposit holding Pleistocene megacerine remains in Sardinia*. *Insular Vertebrate Evolution*, volume 24
- Palombo M.R., Melis R.T., Meloni S., Tuveri C.** (2003), *A new cervid in the Pleistocene of Sardinia: preliminary report*. *Bollettino della Società Italiana Paleontologica*, volume 42, pp. 157-162

- Palombo M.R., Pillola G.L., Kotsakis T.** (2008), *Fossil Mammalian Biotas of Sardinia, Italy. Fieldtrip Guide-Book*. EuroMam Sardinia 2008
- Pisanu W.** 2008. *Studio della consistenza e della struttura di popolazione del cervo sardo nell'areale di Montevecchio*. Tesi di laurea, Università degli Studi di Cagliari
- Pitra C., Fickel J., Meijaard E., Colin Groves P.** (2004), *Evolution and phylogeny of old world deer*. *Molecular phylogenetics and Evolution*, volume 333, pp. 880-895
- Primack R.B., Carotenuto L.** (2003), *Conservazione della natura*. Zanichelli
- Rook L., Abbazzi L., Angelone C., Arca M., Barisone G., Bedetti C., Delfino M., Kotsakis T., Marcolini F., Palombo M.R., Pavia M., Piras P., Torre D., Tuveri C., Valli A., Wilkens B.** (2004), *Osservazioni preliminari sui vertebrati fossili plio-pleistocenici del Monte Tuttavista (Orosei, Sardegna)*. *Rivista Italiana di Paleontologia e stratigrafia*, volume 110, pp. 681-706
- Van Der Made J., Palombo M.R.** (2006), *Megaloceros sardus n. sp., a large deer from the Pleistocene of Sardinia*. *Hellenic Journal of Geosciences*, volume 41, pp. 163-176
- Zachos F., Hartl G.B., Apollonio M., Reutershan T.** (2003), *On the phylogeographic origin of the Corsican red deer (Cervus elaphus corsicanus): evidence from microsatellites and mitochondrial DNA*. *Mammalian Biology*, volume 68, pp. 284-298
- Zachos F., Eckert I., Lorenzini R., Fico R., Hartl G. B.** (2006), *Conservation genetics on endangered red deer from Sardinia and Mesola with further remarks on the philogeography of Cervus elaphus corsicanus*. *Biological Journal of the Linnean Society*, volume 88, pp. 691-701
- *** Ente Foreste della Sardegna (2007), *Censimento 2007 del cervo in Sardegna*. In collaborazione con il Dipartimento di Biologia Animale ed Ecologia, Università degli Studi di Cagliari
- *** Ente Foreste della Sardegna (2008), *Censimento 2008 del cervo in Sardegna*. In collaborazione con il Dipartimento di Biologia Animale ed Ecologia, Università degli Studi di Cagliari